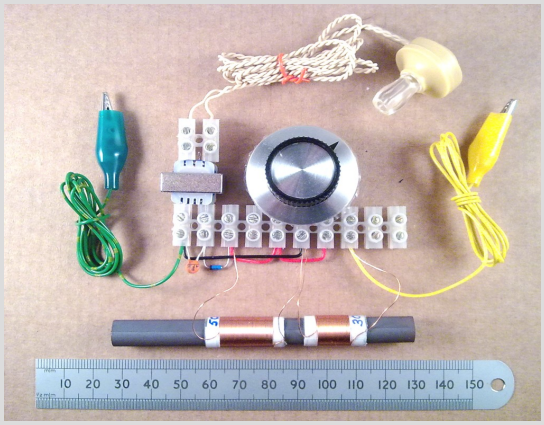
The Choccy Block Crystal Set Radio Kit



I've sold quite a few of these now and people are having success with them. If you're thinking of buying one of the commercial plastic sets without an aerial coupling coil, output transformer and with an untested earphone, please consider this one instead. I can confirm that it is much better and you won't risk the 40% chance of getting a dud earphone that are the current odds. (See The Problem With Crystal Earphones)

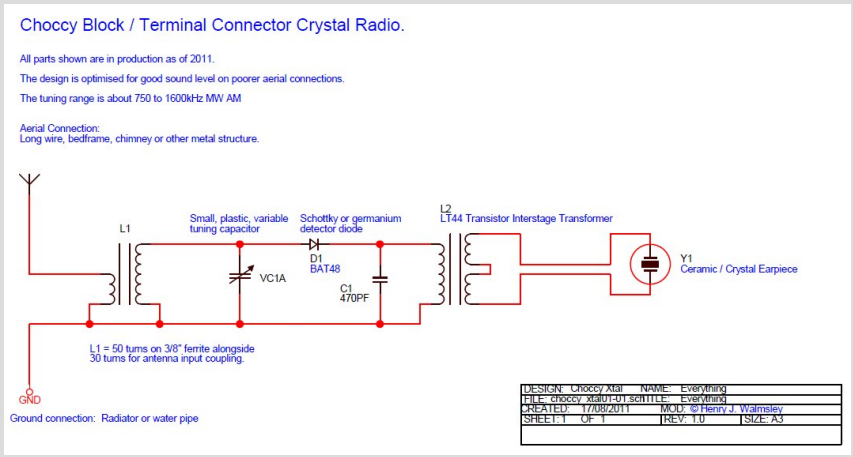
A kit of electronic parts is available on Ebay here: Useful Components Ebay Shop

This is a small crystal radio which can be constructed without soldering using 3A terminal strip or "Choccy Block." It's best to read right through the page first before starting out.

How To Build The Radio

Here is a pdf electronic schematic diagram. If you're familiar with electronics this will be helpful. If not, you can just look at the pictures. In addition to the parts provided in the picture you will need a screwdriver for the terminal block, some pliers, some wire cutters and some form of wire stripper. To make the paper tubes for the coils you will need some paper, glue, scissors and sticky tape.

Schematic Diagram



Link to Schematic Diagram of Choccy Block Crystal Set Radio

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Bill Of Materials:

* 3 Amp terminal strip
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* LT44 transformer L2
* variable capacitor VC1
* 2 M2.5 4mm screws
* 3 M2.5 20mm screws
* 3 M2.5 nuts
* 5 M2.5 washers
* BAT48 schottky diode D1
* 470pF ceramic disc capacitor C1
* ceramic / crystal earpiece Y1
* 30SWG / 0.315mm enameled copper wire 4m
* 1m yellow aerial connection wire
* 1m green earth connection wire
* 1 yellow insulated crocodile clip
* 1 green insulated crocodile clip
* control knob for short shaft
* 100mm long, 9.5mm diameter ferrite rod
* 100mm single core red hookup wire
* 100mm single core black hookup wire
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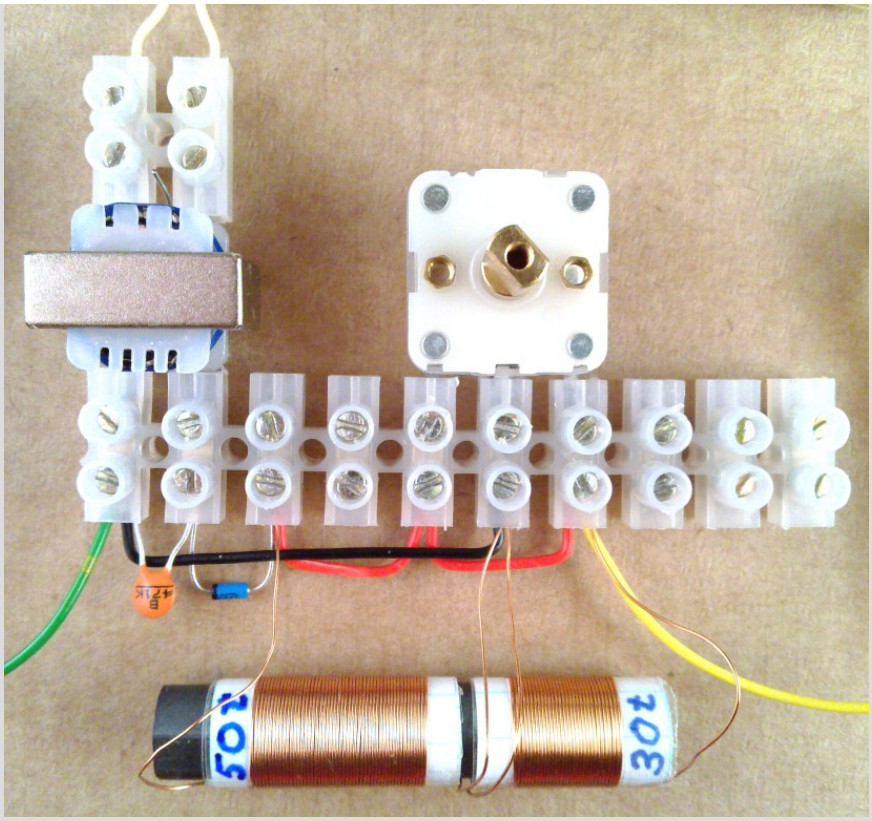
General Connections

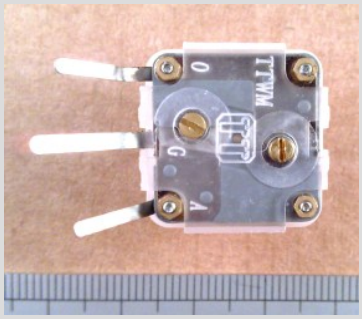
Link to Large Photo of Choccy Block Crystal Radio Wiring

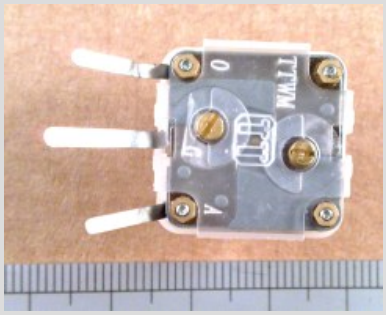


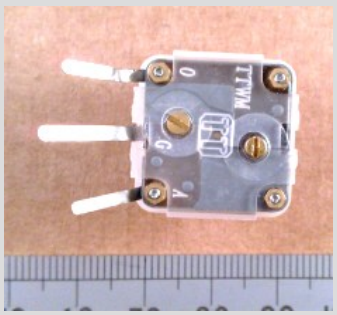
In the photo above you can see each component and where it is connected quite easily, using the large wiring picture if needed. You need to cut a group of two terminals from one end of the block for the connections to the earpiece. The red and black link wires, the aerial and earth wires, and the crystal earpiece wires need to be stripped of plastic insulation where they connect into the terminal block. The coil wire ends need to have the enamel insulation scraped off where they connect in. The LT44 transformer should be connected so that the outer two wires of the end with three wires are connected to the earpiece wires. You can leave the middle wire disconnected. The transformer is best butted right up against the terminal strip which gives it a little bit of support to stop the wires bending. The same applies to the variable capacitor.

The Variable Capacitor Connections

Looking at the variable capacitor from the bottom side, the side without the control shaft, you will see two trimmer screws and the three strip connections. The two trimmer screws add extra fixed capacitance to the variable elements. They should be adjusted as shown in the third photograph for minimum extra capacitance. This is the position where the semi-circular moving plates attached to the screws are clear of the lower metal plates.

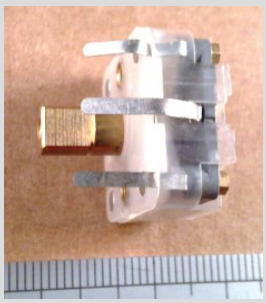
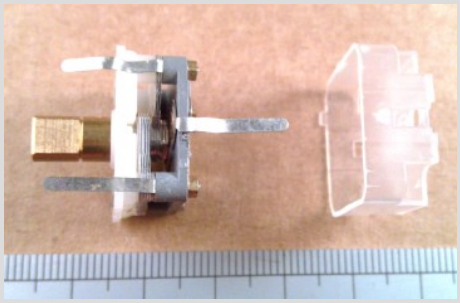
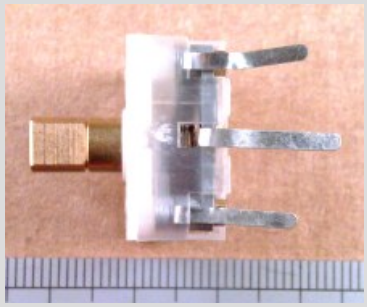






The middle strip is the common ground for the two capacitors and the outer strips are the remaining connections. The variable capacitor is actually two capacitors which are connected together in the

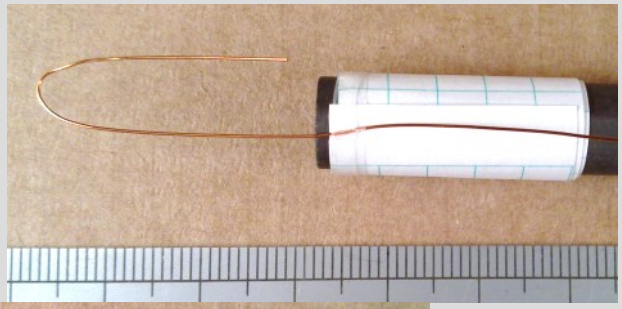
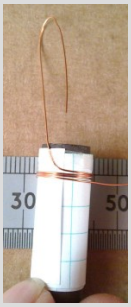
terminal strip circuit. As supplied, the connection strips exit at the side of the top face of the capacitor. To fit it into the terminal strip you need to remove the transparent plastic case of the variable capacitor, and unfold the strips so that they go out of the holes in the bottom face, as shown in the picture sequence.

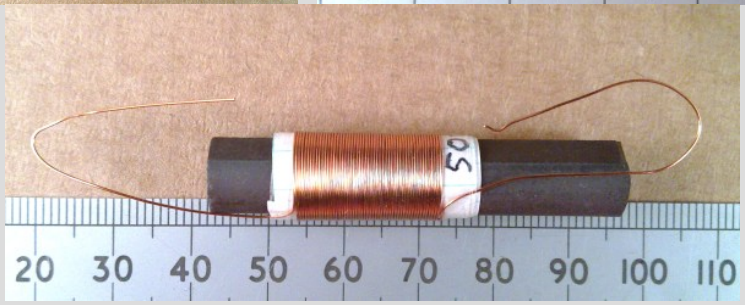




Making the Coils

To wind the coils you need the wire supplied, some sellotape, scissors, ordinary paper and some glue. The process in shown in the pictures. You first need to make two paper tubes by cutting a piece of paper 25mm wide and about 100mm long and another about 20mm wide by 100mm long. The tubes are formed by applying glue to two thirds of the length of the paper and wrapping it loosely around the ferrite rod. The tubes need to be able to slide up and down on the rod, so don't wrap it too tightly. It's best to leave the glue to dry before winding the wire on so that the tube doesn't crush and bind on the rod. The wire is secured at one end of the paper former with a thin strip of tape and then for the larger main coil, wind 50 turns onto the tube. The aerial coupling coil requires just 30 turns. It is better to turn the tube rather than winding the wire around by hand, because winding it around puts a twist in the wire. Again, you need to wind the turns just tightly enough to stay in place so that the coil and tube can still move on the rod afterwards. At the end of each coil, another thin strip of tape holds the far end of the wire in place. If you lose exact count of the number of turns don't worry. It need only be approximate.

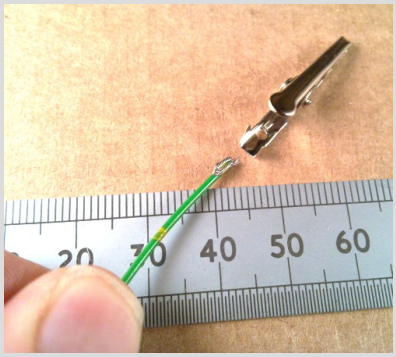
Update: The ferrite rod provided is now 100mm long, so it's a bit easier to handle and you can make the paper tubes a bit wider. You still want to be able to slide the antenna coil close up to the tuning coil though.



Connecting to the Crocodile Clips

The crocodile clips are much more convenient for connecting to aerials and earth connections than bare wires. You need to strip the ends of the yellow and green wires first, then remove the insulating boot from the clips as shown. The metal flaps on the ends of the clips can then be crushed down on the folded-back stripped wire ends to make a firm connection before putting the boot back on from the other end of the wire. To remove and replace the insulating boot, hold the jaws open by clipping them onto some small object.



Finishing Off

It is worth checking that all of the wires are trapped under each screw correctly and that none of them will pull out. When everything is wired as in the main picture, the control knob can be fitted to the shaft of the variable capacitor and you are ready to test.

Testing and Operation

Connect the green earth wire to your earth connection and the yellow aerial wire to your aerial. With the coils in about the position shown, turn the tuning knob until a station is heard. You may find that you can increase the loudness of a particular station a bit by moving the coils around on the ferrite rod, but the adjustment is not critical. There's very little to go wrong, so troubleshooting should be confined to checking that the connections are made as shown. That concludes the building instructions and should get you going. Once it's working you can fix the terminal strips down to a wooden board by carefully banging in nails down through the holes or using the M2.5 screws provided. If you decide to fix the variable capacitor to a front panel, only use the very short 4mm screws provided. These are guaranteed short enough not to foul the insides of the capacitor.

If you want to get on and build it, that's all you need to know but there's more information below which might be useful and some technical discussion.

More Information

Aerials and Earths

I have successfully used this to pick up the main MW station in the UK just by connecting to a central heating radiator for the earth and to the outer casing of a television antenna cable, disconnected from the TV, for the aerial. This is not ideal because the TV cable is nailed to the house which both blocks and drains away a lot of the MW radio signal. It is much better if you can erect a long wire high up in a garden and there are many places online which will show you how to do that, taking the usual precautions against lightning strikes and going near to power cables. Not everyone has a garden though, and you don't want the TV aerial being disconnected on a regular basis, so there are other interesting ways to get an aerial and earth.

Farm and Other Fences

While out walking I wondered if there were any useful MW signals being picked up on farm fences. They are not good aerials for a number of reasons, but they can be quite long which can make up for that. You need to connect the earth clip to the lowest wire and the aerial clip to the highest wire. They will always be a bit corroded so you have to wiggle the clips to get a good connection. If you find a fence in good condition, outside of a deep valley which has dry posts and isn't covered in wet bushes, you will almost always get reception of one or more station. Station pickup depends on the direction of the fence as well, so it's worth trying a few if you are out walking.

Some fences are electrified and it will be pretty clear which those are, those being a single wire with insulated posts. Obviously, I have to say it: Don't use those.

Update September 2011: If you get a high-ish spot and a decent dry fence this can work even better than I expected. I walked up Clee Hill in Shropshire recently and attached the set to an ordinary fence with the ground wire clipped to the standard square mesh below and the barbed wire on top. I wasn't expecting much because the mesh and wire sections have little separation, only a few inches. Signals from Absolute radio, Five Live and another station were good and loud. I needed to move the aerial coupling coil away from the main coil on the rod to help separate the stations. The air traffic radar station in the background is coincidental.
Update October 2011: The New Forest campsite at Holmsley is neither particular high, nor is the fence all that uncluttered; Still I picked up three stations from there and found that it was best using either myself holding the green clip for the ground or the very bottom fence wire which was partially buried.

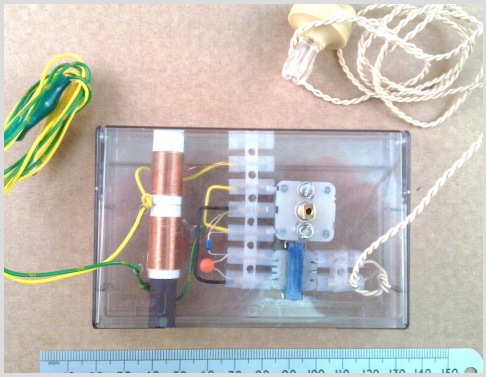
Other Structures

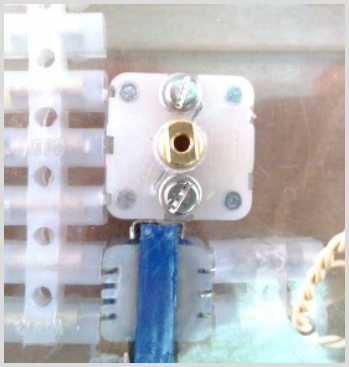
If you see any two metal structures which are not obviously connected together you can see if there is reception available from them. For example at various times in the past, crystal radios have been used in prisons connected to a water pipes for an earth and a bed frame for an aerial. Always stay away from using the electrical mains earth and avoid connecting to household appliances.

Boxing it Up

If you want to carry this around on walks, it's a bit inconvenient in the basic form which was intended to be the easiest way to build it up. If you want to put it in a small box, the first thing to do is to change the variable capacitor connection strips back around so that they once more exit at the same side as the shaft. You can then fit the variable capacitor into the terminal strip upside down so that the shaft faces downwards, or outwards from your box, and the terminal strip and transformer will all be flush with the same surface. I've shown an example below where I have used an old cassette case. This isn't very good because the transformer is too big so you have to cut a hole for it in the back. It doesn't matter which terminal strip connection along the block each circuit node connects into, so you can shuffle the parts along towards the left to save space, and cut off the unused terminals. The tuning knob is specially selected as one which works well with this tuning capacitor: The grub screw is

quite near to the bottom of the knob and it has a recess underneath which clears the mounting screws. This allows it to fit well on the short tuning shaft.





Soldering

If you're happy soldering the wires directly together it is possible to squeeze things up even further. If you shorten the ferrite rod and wind the coils in a small pile you can just about fit the whole thing into an old 35mm film canister. The tuning knob sits neatly at one end. Something a bit like this was used in the Maze prison in the early 1980s. If you want to shorten the ferrite rod to fit it in a box, first use a hacksaw to cut a shallow notch in it. Then wrap the rod in a tea towel and snap it into two pieces at the notch by hand.

Further Technical Discussion

Circuit Operation - Earpieces

Anyone who's played with crystal sets a bit will see that everything in the circuit is pretty standard. There are some small points to note. The beige coloured ceramic / crystal earpieces are quite sensitive and in circuit model terms appear much like a 26nF capacitor in series with some lossy resistance. 26nF is about 6K Ohms impedance at 1kHz. The LT44 is used in reverse to provide a higher impedance audio match to the top of the tuning coil via the diode. Looking into the diode side of the transformer, the impedance actually increases when the the earpiece is connected due to a fortunate broad resonance with the earpiece and transformer leakage inductances. The result is audio which is a bit restricted on bandwidth but which has a fairly good match and efficiency. Some of the ceramic earpieces in the supply chain are very poor at the moment and I recently sent back 67 out of an order of 100 as completely dead on arrival. The ones supplied with the kit are 100% tested.

Diodes

You can use a 1965 Mullard OA81 or OA91 germanium point contact diode if you really want to. In this circuit I've found that the modern low Vf silicon Schottkys work as well as the best germanium diode out of the junk box, and a lot better than a poor one of which there were plenty.

Coils